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## Van Sangyan

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### Note to Authors:

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

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The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

**Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve**

**Photo credit: Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)**

**From the Editor's desk**

*Invasive species are those introduced to a novel environment with negative ecological, economic or social impacts. These negative impacts have been increasingly recognized in both the ecological and economic literatures as awareness of the impacts of invasive species grows, and as globalization increases the pathways and speed of invasions. Negative effects on biodiversity are generally the main concern associated with biological invasions, but invasions also have serious implications for human well-being. Most humans rely on alien species for the bulk of their requirements for food and other basic requirements, although there is increasing realization of the importance of conserving natural capital to ensure the sustainable provision of crucial ecosystems services.*

*The global economy, with increased transport of goods and travels, has facilitated the movement of live species over long distances and beyond natural boundaries. While only a small percentage of transported organisms become invasive, they have a tremendous impact on the health of plants, animals and even humans—threatening lives and affecting food security and ecosystem health. Their negative impact on the economy costs countries billions of dollars in losses to agricultural production and some trillion dollars of environmental cost worldwide annually. Once established, eradication is the most desirable solution, but it can be very expensive to do. Prevention is still the best answer.*

*The negative effects of invasive alien species on biodiversity can be intensified by climate change, habitat destruction and pollution. Isolated ecosystems such as islands are particularly affected. Loss of biodiversity will have major consequences on human well-being. This includes the decline of food diversity, leading to malnutrition, famine and disease, especially in developing countries. It will also have an important impact on our economy and culture.*

*The issue of invasive alien species is caused by human activities associated with international movement, but measures have to be taken at national and local levels. International cooperation can assist it. Prevention is the first step, but where the damage has been done, it can still be reversed if we all work together.*

*New approaches are emerging for describing and evaluating impacts of invasive species, and for translating these impacts into monetary terms. The harmful effects of invasions are now widely recognized, and multiscale programs are in place in many parts of the world to reduce current and future impacts. There has been an upsurge in scientific research aimed at guiding management interventions. Among the activities that are receiving the most attention and that have the most promise for reducing problems are risk assessment, pathway and vector management, early detection, rapid response, and new approaches to mitigation and restoration.*

*In line with the above this issue of Van Sangyan contains an article on Invasive species- It's impact and control measures. There are also useful articles viz.. Cycads of INDIA, Bamboo based Agro forestry system for increasing farmers' income, Solar Energy: A form of clean energy, Social media- Proving to be a boon in forestry research, बहुउपयोगी पौधा: कमल (in Hindi), Causes and effects of water crisis and possible remediation and Seed borer, Sitotroga cerealella in bamboos and its control measures.*

*I hope that readers would find maximum information in this issue relevant and valuable to the sustainable management of forests. Van Sangyan welcomes articles, views and queries on various such issues in the field of forest science.*

*Looking forward to meet you all through forthcoming issues*

**Dr. Naseer Mohammad**

Chief Editor

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## Invasive species- It's impact and control measures

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### Introduction

India is strategically located in Asia, with views to the west of Arabia and Africa and east of Myanmar, Malaysia, and the Indonesian Archipelago. The Himalayan ranges separate India from the rest of Asia geographically. The Bay of Bengal borders it to the south east. The Himalayan ranges can be found in the north, north east, and North West. Kanyakumari is the southernmost point of the Indian Peninsula, while Indira Point in the Andamans & Nicobar Islands is India's southernmost point. Several Forest Invasive Species (FIS) have been imported into India, willingly or inadvertently, throughout the last several decades without recognizing the repercussions. The FIS are further divided into floral (national and regionally distributed weeds and plants), entomological (insects), and pathogenic (pathogens) (fungi). FIS have been found in the above-mentioned categories in roughly equal numbers. There have been no comprehensive studies to date that have inventoried the FIS accessible in its various biogeographical zones. However, because India is such a large country, a detailed inventory may be achieved with the help of some project support. Many invasive species have naturalized in India and are used for a variety of purposes,

including medicinal purposes, religious sentiments, and furniture and decor. Appropriate measures for their control, eradication, and management would need to be created in collaboration with various stakeholders.

Biological species invasions have a wide range of effects on ecological systems. Bio-invasion is a term that refers to the aggressive introduction of invasive species into a new location, new habitat, or a distinct ecosystem within the same ecosystem. This role could be negative, which would have a negative impact on ecosystems (Biswas, 2007).

"An alien species that becomes established in natural or semi-natural ecosystems or habitat is an agent of change and threatens native biological diversity," according to the definition. Although such species may arrive in new places as a result of natural migration, they are frequently introduced as a result of the actions of other species. The most common ways invasive plants, animals, microorganisms, and other species are moved to new environments are through human activities such as global commerce and the pet trade.

According to the definition, "an alien species that establishes itself in natural or semi-natural ecosystems or habitat is a change agent that threatens native

biological diversity." Although such species may migrate to new locations naturally, they are commonly introduced as a result of the actions of other species. Human activities such as global commerce and the pet trade are the most prevalent ways invasive plants, animals, microbes, and other species are transported to new areas. Prey populations may fall over time as invasive predators become more adept at capturing prey, and many prey species may be exterminated from affected ecosystems.

Invasive species, on the other hand, may obstruct native species' access to food, habitat, or other resources. Invading species can efficiently replace native species over time, leading to the loss of many native species in isolated areas. Invasive plants and animals may also act as disease vectors, spreading parasites and illnesses that damage invaded areas further.

Ecologists, biological conservationists, and natural resource managers are all concerned about invasive species because of their fast expansion, threat to biodiversity, and ecological devastation.

Invasive species are homogenizing the world's flora and fauna (Mooney and Hobbs, 2000) and are acknowledged as a key driver of global biodiversity loss. An estimated 80% of endangered species could be lost owing to competition with or predation by invasive species (Czech and Krausman, 1997; Wilcove and Chen, 1998).

Invasive tree species are one of the most significant challenges to native ecosystems. Alien tree species have a substantial impact on the functioning of invaded ecosystems due to species-specific impacts on light availability and nutrient cycling. As a result, alien tree species have

an impact on native creatures that rely on them, such as soil microorganisms, invertebrates, fungi, bryophytes, and vascular plants (Polley et. al., 1997).

Many invasive plants are nonetheless adored by people who are unaware of their weedy characteristics. Others are identified as weeds, yet property owners do little to stop them from spreading. Some species do not become invasive until they have been neglected for an extended period of time. Invasive plants aren't all created equal. Some colonize only tiny areas and do so in a non-aggressive manner. Others may spread quickly and take over enormous areas in a matter of years.

#### **Invasive species have the following features**

Invasive species have characteristics such as being "pioneer species" in different landscapes, being tolerant of a wide range of soil and weather conditions, being a generalist in distribution, producing copious amounts of seed that disperse easily, having aggressive root systems, having a short generation time, high dispersal rates, long flowering and fruiting periods, having a broad native range, and being abundant in their native range.

#### **Current weed control prevention and monitoring techniques**

##### **Chemical**

One of the most prevalent approaches for controlling FIS is to use chemicals. Most chemicals are species-specific, albeit their use is not always ideal due to the environmental degradation and pollution they frequently produce, as well as their effects on other beneficial species.

##### **Mechanical**

Hoes, cultivators, harrows, rotary weeders, discs, ploughs, scythes, mowers, and manual uprooting are all examples of mechanical control. Weeds are physically

removed from the earth and either chopped off or buried.

### **Biological control**

A 'natural enemy' of the plant is used in biological weed control, which is harmless to desired plants. Natural enemies include insects and disease organisms. Other biological controls include parasite plants, animal selective grazing, and highly competitive replacement plants.

### **Crop competition**

Crop competition is one of the most cost-effective and practical ways available to farmers. Using the best crop development practices that are so beneficial to the crop that weeds are crowded out is a common example. Competition, in fact, takes full use of one of nature's oldest laws: "Survival of the Fittest."

### **Tillage**

Most small annual weeds can be buried with tillage. Most annual weeds will be killed if all of their growth tips are buried. Most perennial weeds' root systems are also disrupted by tillage. The root system is severed to the point where the plant succumbs to desiccation before re-establishing its roots. The roots may swiftly re-establish themselves in damp soils or if it rains soon after tillage.

### **Crop rotation**

In some crops, weeds are more common than in others. The hosts for parasitic weeds like striga in sorghum and orbanche in tobacco, in addition to annual weeds, are the crop species planted. Crop rotation is an effective strategy to reduce weed development.

### **Future threats to the FIS**

The Indian economy is heavily invested in agriculture, horticulture, and forestry, and it imports and exports planting materials and products on a regular basis. India has a well-established quarantine system that

regulates the import and export of these materials to prevent hazardous pathogens from entering or exiting the country. Despite the quarantine restrictions, the possibility of certain viruses being introduced into the country or exported to other countries cannot be ruled out. In the forestry sector, various novel infections have entered India in recent decades, along with some foreign tree species introduced through plantation programmes.

### **Preventing the introduction of FIS is being addressed with the following**

#### **Clean equipment and materials**

Before arriving on site, perform due diligence by checking that all equipment, materials, and vehicles are free of invasive plant seeds and plant pieces. Before using any agricultural implements or equipment that may have been exposed to invasive species, they must be thoroughly cleaned.

#### **Limit soil disturbances**

Limiting the spread of invasive plant infestations by avoiding needless soil disturbances whenever possible.

#### **Early detection and eradication**

Because a single plant and small infestations are far easier to control than huge infestations, proactive management of invasive plants through regular monitoring is critical

#### **Immediate re-vegetation of disturbed sites**

Re-vegetate the area with approved species using a time-bound plan to restrict the possible establishment of invasive plants on disturbed ground.

#### **Limit seed introduction in fill**

Prior to moving the material, inspect gravel pits, soil stockpiles, or other fill sources for invasive plants to guarantee the product has a minimal risk of introducing invasive plants.

#### **Education and awareness**



To put the above preventative methods into effect, companies and agencies must build collaborative or individual invasive plant education and awareness programmes.

People must be educated about the detrimental consequences of these weeds as well as how to utilise the raw materials that have been removed for commercial purposes.

### List of some Terrestrial Invasive Alien Plant Species in India

S.No	Name of taxa	English Name
1.	<i>Abutilon crispum</i> (L.) Brizicky	Bladder Mallow
2.	<i>Acacia auriculiformis</i> L. New name <i>Racosperma auriculiformis</i> (L) Benth.	Northern black wattle
3.	<i>Acacia dealbata</i> Link	Silver wattle
4.	<i>Acacia mearnsii</i> De Willd.	Black wattle
5.	<i>Ageratina adenophora</i> (Spreng.) King & H. Rob.	Crofton weed or sticky snakeroot
6.	<i>Ageratina riparia</i> (Regel) R. M. King & H. Rob.	Creeping croftonweed
7.	<i>Alternanthera bettzickiana</i> (Regel) G. Nichols	Red Calico plant
8.	<i>Alternanthera brasiliana</i> (L.) Kuntze	Brazilian joy weed
9.	<i>Alternanthera ficoidea</i> P. Beauv.	Joseph's coat
10.	<i>Alternanthera paronychioides</i> St. Hil.	Smooth joy weed
11.	<i>Alternanthera pungens</i> Kunth.	Khaki weed
12.	<i>Alternanthera tenella</i> Colla	Calico plant
13.	<i>Antigonon leptopus</i> Hook. & Arn.	Coral vine
14.	<i>Argemone Mexicana</i> L.	Mexican poppy
15.	<i>Bidens pilosa</i> L.	Black Jack
16.	<i>Cabombacaroliniana</i> A. Gray	Carolina fanwort,
17.	<i>Cannabis sativa</i> L.	Hemp/ Marijuana
18.	<i>Centrosema molle</i> Benth.	Butterfly-pea
19.	<i>Cestrum aurantiacum</i> Lindl	Orange cestrum
20.	<i>Chromolaena odorata</i> (L.) King & Robin.	Siam weed
21.	<i>Cirsium arvense</i> (L.) Scop.	Canada thistle
22.	<i>Coronopus didymus</i> Sm.	Lesser swinecress
23.	<i>Cryptostegia grandiflora</i> R. Br.	Rubber vine
24.	<i>Cuscuta chinensis</i> Lam.	Dodder
25.	<i>Cytisus scoparius</i> (L.) Link	Scotch broom
26.	<i>Dactyloctenium aegyptium</i> L.	Badi Aankh Phootani bel
27.	<i>Dinebra retroflexa</i> (Vahl) Panz.	Viper grass

28.	<i>Diplachnefusca</i> (L.) P.Beauv.	Brown flowered swamp grass
29.	<i>Dysphania ambrosioides</i> Mosyakin & Clemants	Mexican tea
30.	<i>Erigeron bonariensis</i> L.,	Horseweed / Butterweed
31.	<i>Erigeron canadensis</i> L.	Canadian horseweed
32.	<i>Evolvulus nummularius</i> (L.) L.	Round leaf Bindweed
33.	<i>Hyptissuaveolens</i> Poit.	Pig nut
34.	<i>Ipomoea eriocarpa</i> R. Br.	Purple morning glory
35.	<i>Ipomoea fistulosa</i> Mart. ex Choisy	Bush Morning Glory/ Shrub Ipomoea
36.	<i>Lantana camara</i> L.	Lantana
37.	<i>Leucaena leucocephala</i> (Lam.) de Wit	False/Horse tamarind
38.	<i>Maesopsis eminii</i> Engl.	Umbrella-tree
39.	<i>Mikania micrantha</i> Kunth	Mile-a-minute
40.	<i>Mimosa diplotricha</i> C. Wight ex Sauvalle var.	Giant sensitive plant
41.	<i>Mimosa pigra</i> L.	Cat claw mimosa
42.	<i>Muntingia calabura</i> L.	Jamaican cherry
43.	<i>Opuntia dillenii</i> Haw.	Prickly pear
44.	<i>Opuntia elatior</i> Miller	Prickly pear
45.	<i>Parthenium hysterophorus</i> L.	Congress weed
46.	<i>Pennisetum purpureum</i> Schumacher.	Elephant grass
47.	<i>Prosopis juliflora</i> (Sw.) DC.	Mesquite
48.	<i>Pueraria montana</i> var. <i>lobata</i> (Willd.) Sanjappa & Pradeep	Kudzu
49.	<i>Senna spectabilis</i> (DC.) Irwin & Barneby	Calceolaria shower
50.	<i>Solanum elaeagnifolium</i> Cavanilles	Silverleaf nightshade
51.	<i>Solanum mauritanium</i> Scop.	Bugweed
52.	<i>Sphagneticol trilobata</i> (L.) Pruski	Singapore daisy
53.	<i>Typha angustifolia</i> L.	Lesser bulrush
54.	<i>Ulex europaeus</i> L.	Common gorse

Source: Sandilyan, S., Meenakumari, B., & Babu, C. R. (2018).

Some important Invasive species



*Lantana camara*



*Acacia auriculiformis*



*Coronopus didymus*



*Cannabis sativa*



*Prosopis juliflora*



*Pennisetum purpureum*



*Leucaena leucocephala*



*Opuntia dillenii*

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## Cycads of INDIA

M. Ramcharansharma, Milkuri Chiranjeeva Reddy, Mhiskar Priya Rajendra, Ravula Rohith, Bojja Harish Babu and M. Ooha

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### Introduction

The genus *Cycas* L. is a type genus of family Cycadaceae of Gymnosperms. Originating 300 million years ago during the Carboniferous period, cycads are the oldest group of seed plants. The genus is one of the world's most threatened plant groups with almost 64% of species are at the risk of extinction and have survived three mass extinctions (Donaldson, 2003). They are native to the old world, with maximum species concentration around the equatorial region- eastern and south eastern Asia including Philippines, Eastern Africa, Northern Australia, Polynesia and Micronesia. There are around 114 species known to 10 genera; *Bowenia*, *Ceratozamia*, *Cycas*, *Dioon*, *Encephalartos*, *Lepidozamia*, *Macrozamia*, *Stangeria*, and *Zamia* comprising chiefly Indo-Chinese (about 40 species) and Australian (27 species). These are commonly understory shrubs in forest, woodland or savanna habitats. Among all, *Cycas* and *Zamia* are the most widely distributed and researched genera (Haynes et al., 2012).

*Cycas circinalis* L is the first species which was described in *Cycas* from India (Linnaeus, 1753). In comparison to Indochina and northern Australia, India's cycad flora is rather scarce in terms of diversity and overall in numbers. At present there are 15 species in India, mainly distributed in the southern Western Ghats, Karnataka, Eastern Ghats, North-

Eastern states of India and the Andaman and Nicobar group of islands. On the Indian mainland, all *Cycas* species have been classified as either *C. L. circinalis* or its varieties except *Cycas beddomei* Dyer, which is only found in Andhra Pradesh's Cuddapah Hills, and *Cycas pectinata* Ham.-Buch., a plant native to Bihar and Assam with wonderfully unique megasporophylls. (Raizada & Sahni, 1960; Pant, 1973)

### Diversity in India and IUCN Status

At present 15 species belonging to the genera *Cycas* are seen in India. Among the 15, *Cycas annaikalensis*(CR), *Cycas beddomei* (CR), *Cycas circinalis* (E), *Cycas indica* (DD), *Cycas sphaerica*(DD) are distributed in the southern states of Karnataka, Kerala, Tamilnadu and Andhra Pradesh with *Cycas seshachalamensis* (DD) mainly found in the Seshachalam Hills of Tirupati circle. *Cycas orixensis*(DD) and *Cycas nayagarhensis* (DD) are mainly found in Odisha whereas *Cycas zeylanica* (VU), *Cycas sainathii* (DD), *Cycas pschannae* (DD), *Cycas darshii*(DD) are concentrated in Andaman and Nicobar Islands and West Bengal. *Cycas pectinate* (VU) is mostly endemic to the North Eastern states of Assam, Meghalaya, Tripura and Manipur. No wild population of *Cycas revolute* (DD) have been recorded so far in India.

### Propagation Methods

Cycads are dioecious, which means pollen and seed cones are always found on

distinct plants. Pollen cones are typically thinner, with fewer and smaller scales than seed cones. Except for *Cycas*, all cycad genera have seed cones with a peduncle and cone axis holding spirally organised megasporophylls which do not grow on a cone axis in *Cycas*, but rather emerge separately from the plant stem, similar as leaves (Grobelaar, 2002).

Different strategies have been used to speed up the germination process, and it depends on the species in question. Generally the seeds are sown between April-July (J.S. Khuraijam and R.K. Roy, 2015). Some researchers have proposed that mechanical removal of the fleshy seed coat (sarcotesta), scarification of the bony layer (sclerotesta) of cycad seeds manually or with sulphuric acid ( $H_2SO_4$ ) can improve germination results. The chemical scarification of *Zamia furfuracea* and *Cycas revoluta* seeds with concentrated  $H_2SO_4$  and then soaking them in gibberellic acid ( $GA_3$ ), enhanced germination (Dehgan, 1999). Seed germination in most cycads is thought to be improved by germinating at greater temperatures than the ambient temperature. Generally, the cycad seed germination is optimal at the temperature range of 27°C (Whitelock, 2002) to 30°C (Vorster, 1995). There was no discernible difference in germination between refrigerated and room-temperature *Cycas revoluta* seeds, albeit germination in refrigerated seeds appeared to be more synchronised in this trial as well. For a few cycad species, cold storage is not harmful and may even be advantageous. (Voster, 1995). The holding time of seeds is also important. Seed holding refers to the period during which embryos develop into completely mature stages prior to germination. Generally for *Cycas* species,

the holding time ranges between 4-12 months (Grobelaar, 2002). The vegetative propagation is carried out by the collection of off shoots (suckers). The vegetative propagation should be carried out in April-July from the bulbs. For Indian species, the most preferred media for planting seeds is 1:1, coarse sand and peat mould and for the offshoots it should be 3:2. Before using, the peat mould should be thoroughly treated with pesticide and fungicide (J.S. Khuraijam and R.K. Roy, 2015).

### Threats

Cycads are the world's oldest living seed plants, having survived three mass extinction events. Four cycad species have already become extinct in the wild and can only be found in botanic gardens. The remaining cycad species are threatened by a variety of abiotic and biotic factors, and the IUCN Redlist of Threatened Plants in 1997 named them as one of the world's most endangered plant families (Walter and Gillet, 1998). The declination in the wild is due to clearing of forest, unsustainable harvesting of cycad seeds and forest fires. The recent development of seaside resorts on the islands, clearing off the plants and the existence of populations within protected areas as well as in off-limit, military areas are also contributing for the extinction of the populations.

### Conservation strategies

Successful long-term conservation of cycads can be achieved by combining in-situ and ex-situ conservation methods. The protection of wild populations through the construction of conservation sites necessitates good policymaking and forest dweller co-operation. (Walters 2003)

Ex-situ conservation is beneficial to this uncommon and endangered species of plants in terms of restoring natural

populations and protecting them from other biotic and abiotic variables such as natural disasters and habitat loss. The conservation of vulnerable cycad species relied heavily on ex-situ cycad conservation through a network of botanic gardens (Hill et al., 2003).

The CSIR-NBRI Botanic Garden's Cycad Conservation Centre, which consists of three plant houses: Cycad House, Jurassic Gallery, and Conservatory, is India's only ex-situ conservation centre for this endangered and threatened group of plants. The centre is home to 56 cycad species, including seven Indian cycads. At present, three species of *Zamia* and four Indian species of *Cycas* namely *Cycas beddomei*, *C. pectinata*, *C. sphaerica* and *C. zeylanica* have been propagated and multiplied in the Conservation Centre.

### Conclusion

Cycads are hardy but slow growing plants with attractive leaves and growth habit. Seed dormancy is the major problem faced by the majority of the cycads. Also, the Seed holding duration is another major constraint. In some cycads seed holding capacity may last few weeks and in some, it may take many years. As a result, seed germination of cycads takes long time to germinate as compared to vegetative propagation. Hence the further findings are necessary for the exploitation and for the varied uses and conservation of the *Cycas* species (J.S. Khuraijam and R.K. Roy, 2015).

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## Bamboo based Agro forestry system for increasing farmers' income

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### Introduction

Bamboo based agro forestry systems of India are one of the important component to improve socio-economic status, annual income of stakeholders as well as environment friendly. The agro forestry system is recognized as an important integrated farming practice since time immemorial, to fulfill the domestic need of food, fodder, fuel wood, fiber and timber along with aesthetic and environmental services to the society. However, woody perennials have been reduced gradually due to more demand of food grains on limited land resources in entire world in general and India in particular. National Commission on Agriculture (NCA) 1976 suggested for implementation of social forestry programme which covered farm forestry, extension forestry, reforestation in degraded forests and recreation forestry. This system was supported by government because of its role in improvement in soil health, nutrient cycling, carbon sequestration and better economic return in comparison to existing cropping systems with less use of natural resources. To promote agro forestry, various specific initiatives such as National Agriculture Policy (NAP) 2000, Planning Commission Task Force on Greening India 2001, National Bamboo Mission 2002, National Policy for Farmers 2007, Green India Mission 2010 and finally a dedicated National Agro forestry Policy was approved by Government of India in 2014. This policy was recommended for setting

up of a Mission or Board to address development of agro forestry sector in an organized manner. To implement the suggestion, a sub-mission on agro forestry has been initiated under the sustainable agriculture in 2016 by Ministry of Agriculture and Farmers Welfare, Government of India. In common parlance, two factors determine the adoption of agro forestry in any specific region: one is relative profitability with other existing crops and second is the price volatility of wood. Farmers allocate their resources in production of various commodities on the basis of signals they receive from markets. The growing of tree on farms for market seemed to farmers in many regions of India a more profitable option than field crops. However, in spite of relative higher profitability to farmers and several concerted efforts made by government, the adoption of agro forestry has not reached at expected level. Our Prime Minister has set the target of doubling farmers' income by 2022-23 over that in 2015-16. To achieve this goal, it would require significantly faster growth and synergetic interaction among all variables those affect farmers' income. Agro forestry is one of the land uses to fulfill the commitment for Nationally Determined Contributions (NDCs) of our country and reduce emission of Greenhouse Gases (GHGs) by application of carbon, water and land footprints.

**Restructured national bamboo mission**

Recently, Union Minister for Agriculture and farmer's welfare launched logo for National Bamboo Mission on 8th September, 2020 indicating "Green Gold Aka Bamboo" symbolised by Green and Yellow colour where the figure shows bamboo culm in the centre of a circle composed of half farmers and an industrial wheel, stating the objectives of NBM. The Minister also launched the 22 clusters in 8 states to increase the export of Bamboo Products and to protect the local artisans for

sustainable source of Income. Goal of doubling farmer's income is being achieved with the concerted efforts of all stakeholders in the bamboo sector due to the importance of bamboo. Where in 2017 amendment of Indian Forest Act 1927 was done, to remove bamboo from the category of trees which can help everyone to undertake cultivation and business in bamboo and its products.



**Fig-1 Zinger intercropped with *Bamboosa bamboo***



**Fig-2 Chilli crop under *Bamboosa bamboo***

Relative profitability of Bamboo based agroforestry system. The comparative economic viability of Bamboo based agroforestry system with Zinger-Haldi-Chilli system, prevalent in study area is presented in fig. 1& 2. It showed that agroforestry system is able to enhance farmer's income about double in five years and triple, if farmers get incentive of their carbon sequestered by agroforestry system in comparison to existing Zinger-Haldi cropping system. It is verified that if a farmer growing Zinger-Chilli – Haldi continuously at his farm for five years, he could receive net

#### **Conclusion**

Poor man's timber another name of Bamboo which is a versatile and durable resource used as unique alternatives of timbers in the rural culture for creativity

and recreation purpose creates demand of bamboo raw material for rural artisans in rural industry. To achieve the objective of doubling farmers income based on utilization of indigenous knowledge and skills for selecting the suitable location specific bamboo-based agroforestry system or technology, its adoption, implementation and management will be beneficial. The comparative economic viability of Bambo based agroforestry system with continuous zinger-chilli crop rotation showed that agroforestry system is able to enhance farmers' income more than double in 5 years and triple if farmers get value of their carbon sequestered by agroforestry.

## Solar Energy: A form of clean energy

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### Introduction

Sun also known as “Surya” is the creator of all the environmental processes on earth. Sun provides us with the solar radiation which consists of Photons which have proven to contain high energy levels. Solar radiation helps in the maintenance of the earth’s ambient temperature. The amount of energy from the sun that reaches Earth each day is enormous. All the energy stored in Earth's reserves of coal, oil, and natural gas is equal to the energy from only 20 days of sunshine. Various life cycles such as photosynthesis, ecological cycles such as water-cycle, photochemical cycles which help up in the formation of oxygen (though in less amount). Solar radiation are basically Short-wave radiations. After entering the earth these short-wave radiations are converted in to long- wave radiation which then help in the maintenance of the general temperature on the earth which is beneficial for all the ecological cycles occurring on the planet earth.

Solar photovoltaic technology is one of the most significant renewable technologies particularly for remote and standalone consumers those are away from grid supply system. Invented in 1955, their main focus was on providing electrical power to the space crafts. Recent developments and innovations have significantly reduced the cost of photovoltaic systems; at the same time

increased the efficiency of the system substantially. Since long they have become commercially viable in small power applications.

### Solar radiation – as generator of energy

Solar radiations are a big source of energy as it consists of high energy particles which help up in the excitement of electrons. Nowadays, science has established to such a level that mankind is now able to harness this energy for the fulfillment of his own needs. Sun, the powerhouse of energy provides solar radiation which if used efficiently can help up un the biggest problem of all the developments i.e., pollution, as in today’s world till now no technology has been developed which does not cause any pollution. Even though, solar appliances do cause pollution such as e-waste which can be managed by using 3 r’s which are reduce, reuse, and recycle.

### Solar power- the future

Science has developed ways and experiments through which we know about the properties of the solar radiation. Nowadays, various solar appliances have been developed which can convert the solar energy in the form of energy. This energy can be distributed in to two parts which are heat and electricity.

### Solar energy as a source of electricity

Solar energy has been proved to be helping in the generation of electricity. The appliances which are used for the

generation of electricity based on the principles of solar energy are termed as Photo-voltaics. These appliances help in the conversion of this useful form of energy into electricity. The main dependency which the photo-voltaics require is the position of sun, presence of sunlight, duration of sunlight, angle of the appliance towards sun etcetera. The photovoltaic appliances are made by an association of number of solar cells into an array which combine to form a solar panel. They are mainly made up of silicon particles, but nowadays to improve their efficiency Cadmium telluride is also being used which has proved to increase the efficiency of the solar cells by approximately 95% which is near to the perfect quantum level. The 95% efficiency photovoltaics use the 3-junction system. The non - junction solar photovoltaics also have an efficiency of 45%.

These appliances work on the principle that when solar radiation falls on the solar panel, the solar panels convert the solar energy into electricity. In technical terms, the high energy photons (from the solar radiation) when fall on the solar panels, the electrons present inside the solar cells get excited and these highly excited electrons generate electricity. Nowadays, particularly in Himachal Pradesh solar-fences are also being used by the farmers to protect their fields from animals or trespassers. A solar fence works like an electric fence which delivers a brief yet fierce shock when human beings or animals come in contact with the fence. The shock enables a deterrent effect while ensuring that no loss of life is caused.

#### **Solar energy as a source of heat energy**

These are a group of other solar based devices which convert the solar energy into heat. The generated heat can be

utilized in the form of cooking, water heating and purification of water. The appliances which convert solar energy into steam are known as solar steam generating systems through which steam generated can be used for cooking purpose. Solar ponds store the heat energy received by the solar radiations which can fulfill various purpose such as heating of buildings or as industrial hot water for electricity generation. Solar desalination units undergo processes such as condensation and evaporation and can convert salt water into purified water by evaporation and condensation process.

#### **Application of Solar energy in agriculture**

Solar energy can be used in agriculture in a number of ways, saving money, increasing self-reliance, and reducing pollution. Solar energy can cut a farm's electricity and heating bills. Solar heat collectors can be used to dry crops and warm homes, livestock buildings, and greenhouses. Solar water heaters can provide hot water for dairy operations, pen cleaning, and homes. Photovoltaics (solar electric panels) can power farm operations and remote water pumps, lights, and electric fences. Buildings and barns can be renovated to capture natural daylight, instead of using electric lights. Solar power is often less expensive than extending power lines.

#### **What are the limitations of solar power systems?**

The main challenge today is to promote the development and commercialization of renewable energy sources for widespread adaption. This requires a smooth transition from fossil fuel-based generation system to renewable energy supported system. The two main obstacles in this regard are efficiency constraint and cost of renewable

sources. Photovoltaic systems are one of the most promising and prominent candidates of emerging renewable sources. Lack of capability of bulk production of energy, system efficiency, availability, reliability, feasibility, sustainability, suitable geographical sites, lifetime, capital cost/investment, commercialization, energy storage, complex manufacturing process and finally cost of energy are the major factors affecting the growth of renewable sources like solar energy systems. Improved performance and cost reduction can increase the use and popularity of the sources.

Now, from the above-mentioned information we know that solar radiation has applications that are beneficial and have a potential to provide clean energy, but the main problem lies in the fact that this beneficial technology is not getting very much attention from the general public. This lack of implementation on a large commercial scale is due to some constraints in the process which are discussed further.

### **Solar radiation technology - A technology with minimum implementation on ground level**

In today's world, mainly with the newest technological inventions we still fail to get their best output. This is due to the lack in the improvisation stage. We are unable to reach out the maximum number of people with our technology. We are unable to make people think that what are the benefits to his/her family & what are the benefits of the technology to our planet. This can be due to the fact that we are not able to connect these scientific innovations with the emotions of the people. Many people around us know about clean energy but still they don't want it to implement on

their personal level. The main psychology behind this constraint is the fact that:

- The thinking of "Why Should I"
- Lack of emotional connectivity with science
- High prices of the installation process.
- Lack of complete information regarding the benefits.

The lack of extension services also is the main reason for their reach out towards general public. In most of the governmental institutions the scientists develop the technology but the extension workers often fail to present the benefits of the new technology to the general public. Thus, as a fact the technology is unable to reach the Right person at Right place & at Right time.

### **What should be done to improve the reach of these technologies?**

- Firstly, the basic step is the spread of awareness about the potential benefits.
- Preparation of various commercial especially on TV, Newspapers, Pamphlets which show how clean energy technologies can help the individual itself, his family + environment.
- Attachment of subsidies and help of local level administration to promote the clean energy and various basic doubts regarding it to the people.
- Alone subsidies are not enough hence; we should also plan & manage to encourage people through marketing skills which are often followed by private companies for delivering the advantages of their product.

- Public Private Partnership model can also be followed to improve the production, marketing & reach of the technology to the common people.
- Thus, in a nutshell the clean energy technology such as the solar energy

has a higher potential in the market. All we need is the proper marketing skills, better subsidies, if needed then follow up of the PPP (Public Private Partnership) model, connect people emotionally with this technology.

## Social media- Proving to be a boon in forestry research

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### Introduction

With the advent of the internet, people now have access to a vast array of information, as well as a plethora of opportunities to use social media (McNab, 2009). Without a doubt, the internet and social media have made it easier for businesses to communicate with their customers. It enables professional organisations to improve communication with their members, policymakers, and the general public (T. Bogdanou et al., 2013). Social media is a grouping of internet-based applications that facilitate social interaction through the creation and exchange of user-generated content (Wikipedia, 2012a). The introduction of Web 2.0 in 2004 facilitated the use of social media, which can be defined as "the version of the web that is open to ordinary users and where they can add their own content" (Brown, 2009: 1). In contrast to traditional one-way corporate communications, they are distinguished by two- or many-way communications. The increased adoption and use of social media, as well as the various media channels now available, has significant implications for how the Forestry Commission (FC) communicates with stakeholders and the general public.

Along with social media, this report focuses on other recent technological

developments such as mobile internet technology (i.e., smartphones and tablet computers), which enables the use of social media almost anywhere and at any time, and facilitates innovative new forms of communication between organisations and the general public via software applications and the use of features such as Global Positioning System (GPS) tools (Stewart et al., 2012). Social media platforms such as Facebook, Twitter, YouTube, and Pinterest offer the public a variety of options for commenting, learning, organising, and managing their interactions and interests related to forests and woodlands.

### General outlook of social media channels and monitoring tools:

This section provides an outlook of some of the available media channels. It offers an overview of some of the most influential channels and tools available today, as well as other media types that may be of interest to the FC and may be used more in the forestry sector.

### Social networks and online forums

**Social networks** are changing the way people communicate and share information. According to Brown, they are used by millions of people worldwide on a daily basis and are essentially online communities based on things like friendship or common interests (2009: 50).



They include a variety of ways to interact, such as instant messaging, e-mail-style messaging, file sharing, and blogging, and they frequently allow integration with other media channels and platforms. The FC currently has several Facebook pages that are active, including national pages, project pages, and visitor site pages.

### **Forums**

These are the most traditional type of online social media, focusing on discussion around a specific topic or interest; users post their opinions or contribute information to the forum site, and others can respond and comment on this (Zarella, 2009: 147).

### **Blogs, micro-blogs and vlogs**

A **blog** is a type of content management system in which users can publish short pieces of text known as "posts." Blogs are similar to websites in many ways, but they are distinguished by having a title and a date, as well as the ability to post comments. As the name implies, micro-blogging is a type of blogging in which only very short text entries are made, with a character limit (140) for each post (Brown, 2009: 36-7; Zarella, 2009: 31). There are several FC Twitter accounts, including national and team accounts, as well as some devoted to specific topics such as tree pest news and tumblr. **Vlogs**, as the name implies, use video as a medium for blogging. They are a type of Web Television and a popular YouTube category (Wikipedia, 2012b).

### **Wikis**

These are web pages that allow anyone with site access to add or modify existing content without having to understand complex web markup language (i.e. HTML) (Brown, 2009: 39).

### **RSS**

RSS is an abbreviation for Really Simple Syndication. It is a web feed format or

aggregator that allows a user to keep up with web content such as blogs, podcasts, and news headlines from multiple sources in one place, rather than having to check individual websites (Brown, 2009: 42). RSS content is supported by Internet Explorer, Firefox, Yahoo, Google, Microsoft Outlook, and Safari.

### **Media-sharing websites**

These sites allow users to upload their own multimedia files. Sites that allow video uploads, such as YouTube, photos, such as Flickr and Photobucket, and presentations, such as SlideShare, are examples of media-sharing sites.

### **Podcasts and vodcasts**

**Podcasts** and audio streams are essentially internet radio programmes that are typically downloaded rather than broadcast in the traditional sense (Brown, 2009). **Vodcasts** are essentially podcasts that use video instead of audio, and they are frequently used to distribute web television series.

### **Smartphones and tablet computers**

Because of their mobility, multimedia capability, and internet connectivity, smartphones and tablets can also facilitate data gathering or data sharing, and are especially useful in gathering location-specific information via location-aware applications that use global positioning systems (GPS), mobile phone infrastructure, or wireless access points. Text and other media (e.g., photos) generated by users can thus be linked to a specific location, and application content, information, and resources can be tailored based on the user's location.

### **Mobile apps**

In the last two years, the number of mobile apps downloaded to smartphones and tablets has skyrocketed, "with figures rising from 300 million apps downloaded in 2009 to five billion in 2010." (Boulos et

al., 2011: 11). ForestXplorer, a mobile application developed by the Football Club in England, is already available. It was initially only available for iPhone users, but it was recently made available for use on Android-powered devices as well. Users can use the app to find their nearest FC woodland, learn about the site and what activities are available there, download trail maps, learn more about trees with a tree identification module, search for nearby events, and plan camping and log cabin breaks with Forest Holidays (Forestry Commission, 2012).

### Recent social media advancements in forestry

#### **MSTriPES (Monitoring System for Tigers: Intensive Protection and Ecological Status):**

MSTriPES is an acronym that stands for "Monitoring System for Tigers: Intensive Protection and Ecological Status." It is a software monitoring system introduced by the Indian government in some tiger reserves in 2010. The goal is to make Tigers less vulnerable. It is a platform that employs cutting-edge technology to aid in effective patrolling, assess ecological status, and reduce human-wildlife conflict in and around tiger reserves. This programme collects information from the field using GPS, General Packet Radio Services (GPRS), and remote sensing, creates a database using modern Information Technology (IT) based tools, and analyses the information using GIS and statistical tools to provide inferences that allow tiger reserve managers to better manage their wildlife resources.



**MSTriPES app**

#### **PlantNet**

The app is essentially an image search engine that can be used to help people identify flowers and plants with the tap of a smartphone. Working with images from a massive data base collected by Plant Net users aids in the identification and addition of information about the quality of images and plants.



**PlantNet app**

#### **Project 'eForest Fire- Himalayan Forest Fire Prediction**

A mobile app and predictive modelling are being developed to help reduce the occurrence of forest fires. This app provides fire points and assists in identifying fire-prone areas to assist experts in developing preventive measures. The mobile app eForest Fire provides input. When users submit data, it is visible

in the webgis.co.in portal. However, it should not be interpreted as a real-time fire alert for all app updates. "The project forecasts fire priority villages using remote sensing and a GIS (Geographical Information System)-based model that takes nine factors into account (poverty, rainfall, temperature, slope, elevation, forest type, forest cover, and population density)." The points we earn from the app are used to improve the prediction."



**eForest Fire app**

#### **4. The Farm Tree:**

This mobile app provides a user-friendly, bi-lingual e-platform for farmers to have all basic information on 20 commonly grown promising agroforestry tree species at their fingertips. It covers a variety of topics such as common name, botanical name, family, potential area, silvi-cultural requirements, nursery techniques, planting techniques, tending operations, appropriate agroforestry systems, and so on. This app provides relevant content that is accompanied by beautiful original photographs, making it more useful for forestry professionals, naturalists, and forest department personnel.



**Farm Tree app**

#### **Geo tagging**

The forest department in Uttar Pradesh has used geo tagging of plants via a quick capture app to monitor saplings in the forest, a first of its kind. This app will assist in keeping track of each and every tree planted at various locations throughout the state, as well as tracing the location of all saplings through the app, verifying the plants, and reporting to the government.

#### **Some of the issues concerning social media include:**

- The quality and security of content and data.
- Processes and procedures that are adaptable to new digital technologies.
- Organizational digital literacy
- Understanding social media usage among various audiences
- Using social media to source and manage interactive relationships.

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## बहुउपयोगी पौधा: कमल

सौरभ दुबे, पंकज कुमार एवं आकाश शुक्ला

वन संवर्धन, वन प्रबंधन एवं कृषि वानिकी प्रभाग

उष्णकटिबंधीय वन अनुसंधान संस्थान

(भारतीय वानिकी अनुसन्धान एवं शिक्षा परिषद्, पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार)

जबलपुर

### परिचय

कमल एक जलीय पौधा है, जो नेलुम्बोनेसी (Nelumbonaceae) परिवार का सदस्य है। इसका वानस्पतिक नाम *नेलुम्बो न्यूसिफेरा* (*Nelumbian nucifera* Gaertn.) है। कमल का पुष्प देखने में इसका अत्यन्त ही मनोरम होता है, तथा इसका भारत सहित अनेक एशियाई देशों में बहुत अधिक सांस्कृतिक व धार्मिक महत्त्व है।



भारत तथा वियतनाम में इसे राष्ट्रीय पुष्प रूप में मान्यता प्राप्त है। यह भारत में विशेष रूप के उत्तर व मध्य भागों सहित दक्षिण, दक्षिण पूर्व एशिया एवं पूर्वी एशिया के अधिकांश देशों के तालाबों, झीलों, पोखरों, धीमे बहाव वाली नदियों व दलदली भूमियों आदि में पाया जाता है। कमल की गोलाकार पत्तियां लम्बे खोखले पत्रदण्ड के साथ होती हैं, जो कि पत्तियों को पानी की गहराई से सतह के ऊपर बढ़ने में सहायक होती हैं। पत्तियों की ऊपरी सतह चिकनी होती है, जो पानी को अपने ऊपर जमा नहीं होने देती। इनका

व्यास लगभग 80 से.मी. तक हो सकता है। जड़ें पानी के तल की मिट्टी व कीचड़ में जमी हुई होती हैं, जिसे मृणाल कहा जाता है। फूल पानी की सतह से ऊपर डंठल के सिरे पर लगते हैं, जिनका व्यास 30 से.मी. तक हो सकता है। चीन तथा जापान आदि देशों पायी जाने वाली कुछ किस्मों में पुष्प पर एक हजार से अधिक पंखुडियों हो सकती हैं। पंखुडियों के झड़ जाने के बाद शंकुनुमा छिद्रित बीज क्षत्र बच जाता है, जिसमें हरे रंग के गोलाकार बीज होते हैं। बीजों के सूखने पर उनका रंग काला हो जाता है, जिसे कमलगट्टा कहा जाता है।



### विभिन्न नाम

भारत सहित ज्यादातर एशियाई देशों में कमल को बहुत ही महत्त्व दिया जाता है। हिंदी तथा संस्कृत में इसे अनेक नामों से जाना है, जैसे – नीरज, पंकज, सरसिज, पद्म, जलज, अंबुज, पुंडरीक, इंदीवर इत्यादि तथा अंग्रेजी में इंडियन लोटस या सैक्रेड लोटस कहते हैं।

विभिन्न एशियाई देशों में कमल एक महत्वपूर्ण घटक है और इसके पौधे के प्रत्येक भाग का उपयोग किसी न किसी रूप में किया जाता है।

### उपयोग

ज्यादातर दक्षिण एशिया, दक्षिण पूर्व एशिया, चीन एवं जापान आदि देशों में कमल के पौधे के अधिकांश भागों का उपयोग औषधीय, भोजन, धार्मिक अनुष्ठानों, सजावटी वस्तुओं के रूप में किया जाता है। चीन तथा जापान जैसे देशों में इसकी खेती की जाती है।



### फूल

कमल के फूलों की पंखुडियों का उपयोग विभिन्न प्रकार के भोज्य पदार्थों व व्यंजनों को सजाने या सुंदर दिखाने के लिए

किया जाता है साथ ही साथ इसकी पंखुडियों से बनी चाय जिसे पूर्वी देश खासकर कोरिया आदि में लोटस टी के नाम से जाना जाता है। वही चीन में इनकी पंखुडियों को गुलकंद की तरह तैयार किया जाता है। कमल की पंखुडियों से बने ज्यादातर पदार्थ शीतल प्रकृति के होते हैं, जिन्हें गर्मी के मौसम में अधिकांशतः प्रयोग किया जाता है।

### कंद

उत्तर भारत में कमल ककड़ी कहे जाने वाले इसके कंद को बतौर सब्जी खाया जाता है, वही जापान और चीन में इसे कई प्रकार के भोज्य पदार्थ जैसे- चिप्स आदि बनाकर तथा अन्य वाद में उपयोग

हेतु विनेगर आदि से संरक्षित कर वर्षभर प्रयोग किया जाता है।

### पत्तियाँ

कमल की बड़ी पत्तियों का उपयोग भोजन को लपेटकर पकाने तथा रखने के लिये किया जाता है, सामान्य तौर पर इन्हें खाया नहीं जाता है।

### बीज

फूल की पंखुडियों के गिर जाने के बाद डिस्क के आकार का बीज छत्र बच जाता है जिसमें गोलाकार हरे बीज होते हैं। इन्हीं हरे बीजों को सूप या सब्जी के रूप में बनाकर बहुत चाव से खाया जाता है।



सूखकर काले हो चुके पके हुये बीजों को भूनकर मखाने के रूप में खाया जाता है और इसके चूर्ण का हल्वा जो कि उत्तर भारत में खाया जाता है, बहुत पौष्टिक व बलवर्धक होता है।

### अन्य उपयोग

कमल के सभी अंगों का उपयोग किसी न किसी रूप में किया जाता है। इससे अनेक प्रकार की आयुर्वेदिक औषधियाँ भारत में बनाई जाती हैं। चीनी व यूनानी दवाओं में भी इसका प्रयोग होता है। सजावटी पौधों के रूप में इसे उद्यानों व घरों के बागीचों में लगाया जाता है। भारत सहित अन्य एशियाई देशों में इसके फूलों से मंदिरों व अन्य धार्मिक स्थलों को सजाया जाता है।

### कमल से प्राप्त रेशम (Lotus Silk)

यदि हम रेशम की बात करें तो हमें रेशम क्रीट से प्राप्त होता है या कृत्रिम तरीके से सिंथेटिक रेशम,

जिसका प्रचलन सभी जगहों पर हैं, परंतु कमल से प्राप्त रेशम बहुत कम प्रचलित हैं। इसके कम प्रचलित होने का कारण इसको बनाने में लगने वाला परिश्रम, समय व कार्य दक्षता हैं, जो कि उसे सामान्य रेशम से 10 गुना तक अधिक मूल्यवान बनाता हैं। इसको बनाने की प्रक्रिया पूर्ण



रूप से प्राणी क्रूरता से मुक्त होती है। कमल पौधो के दंठलो को सावधानी से चयनित करके उससे निकलने वाले सूक्ष्म रेशों को धागों का रूप दिया जाता हैं तथा बुनाई करके कीमती रेशमी कपडा तैयार किया जाता हैं। इस प्रकार का रेशम केवल म्यांमार, वियतनाम व कम्बोडिया जैसे देशों में कुछ ही स्थानों पर बनाया जाता है।

### संस्कृति व कला में स्थान

हिन्दु तथा बौद्ध संस्कृतियों में इसे शांति, समृद्धि, पवित्रता व दिव्यता के प्रतीक के रूप में देखा जाता है। भारत के प्राचीन साहित्यों व धार्मिक ग्रंथों में अनेक स्थानों पर किसी अन्य को सुंदरता की उपमा देने के लिये कमल पुष्प की तुलना या समानता उससे की जाती रही है।

प्राचीन मंदिरों के स्थापत्य में अनेक स्थानों पर इसको उकेरा गया हैं। अजंता की चित्रकारी में भी कमल को दर्शाया गया है। अन्य एशियाई संस्कृतियों में भी इसे विशेष मान्यता मिली हुई हैं। चीन में कमल को दीर्घ आयु का प्रतीक माना



जाता है वहीं कोरिया की हांजी कला में इसका विशेष महत्त्व हैं। जापान तथा वियतनाम में कमल को गंदे पाने से निकलकर सुंदर रूप में खिलने के कारण इसे पवित्रता का प्रतीक माना जाता है।

### धार्मिक महत्व

कमल के पुष्प न केवल देखने मे ही मनमोहक है, वरन् इसका हिंदू, जैन व बौद्ध धर्म मे महत्त्वपूर्ण स्थान है। विभिन्न प्राचीन मंदिरों के स्थापत्य मे देवि – देवताओ की मूर्तियों के हाथो को कमल के



"लक्ष्मी: पद्मासना देवी पद्महस्ता हरिप्रिया"

पुष्पो से सुशोभित दिखाया जाता है तथा उनका आसन भी कमल के पुष्प के रूप मे दर्शाया जाता है। विशेष रूप से देवी लक्ष्मी को कमल से सम्बद्ध

बताया जाता है, पुराणों में उन्हें कमला, पद्मम्जा आदि नामों से भी जाना जाता है।

देवी सरस्वती व भगवान ब्रम्हा को कमल पुष्प धारण किये हुये तथा कमल पर ही आसीन बताया जाता है तथा भगवान विष्णु को कमलनयन, राजीव लोचन आदि नामों से पुकारा जाता है। अन्य धार्मिक मान्यताओं में भी इसका बहुत विशिष्ट स्थान है। कमल का उपयोग भारत

सहित एशिया के बहुत से देशों में धार्मिक अनुष्ठानों में किया जाता है।

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## Causes and effects of water crisis and possible remediation

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### Abstract

Water crisis is the inadequate supply of fresh water to meet the standard water demand. The shortage is the global problem. Two types viz. physical and economic water scarcity have been defined. The scarcity may be caused by different factors and has a huge impact on hunger, health, poverty, habitat loss and destruction of ecosystem. In the present article we have discussed the causes and effects of water crisis and its possible remediation.

Key words: Water scarcity, causes, effects, pollution, solution

### Introduction

Water, a tasteless, colourless and odorless, inorganic substance is composed of hydrogen and oxygen, the chemical formula of which is H<sub>2</sub>O. Each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. It exists in nature in gaseous, liquid and solid state and being a universal solvent it has the ability to dissolve many substances. It is invaluable for human uses

for drinking, bathing, cooking, cleaning, washing, watering plants etc. It is the most vital components responsible for all known forms of life. But water scarcity is a growing concern worldwide. It may be caused particularly by growing fresh water use and depletion of usable fresh water resources. In the present communication the causes and effects of water scarcity and possible remediation have been discussed in length.

The total volume of global water is estimating at 1,386 billion km<sup>3</sup> with 97.0 percent being salt water and 3.0 percent being fresh water. Out of 3.0 per cent of fresh water, 69.0 per cent of it is frozen in the form of ice as glaciers at the top of the poles and mountains, 30.0 per cent is deposited in the rock below the ground as ground water and only 1.0 per cent is flowing through the rivers, canals or stored in the ponds, lakes, wetlands etc. Of the fresh water, only 0.3 per cent is in the liquid form on the surface (Downing *et al.* 2006).

**Table 1. Water distribution on Earth**

Source	Volume in cubic kilometer	
	Fresh water	Salt water
Oceans, Seas and Bays	0	1338000000
Ice sheets, glaciers & permafrost	24364000	0
Ground water	10530000	12870000
Surface water	122210	85400

Atmosphere	12900	0
Total	35029110	1350955400

**Causes of water crises**

Water crisis is the inadequate supply of water as per the demand of the ecosystem. Water scarcity involves water stress, water shortage or deficit and water crisis. It can be result of two mechanisms: physical water scarcity and economic water scarcity. Physical scarcity of water occurs due to inadequate natural water resources to meet all demands needed for ecosystem to function effectively and economic water scarcity is caused by a lack of investment in infrastructure or technology to draw water from the rivers, aquifers or other water resources (Rijsberman 2006). The shortage may be caused by climate change such as altered weather patterns including drought or floods, increased pollution, increased human demand and overuse of water and is driven by growing fresh water use and depletion of usable fresh water resources.

The crisis about the shortage of fresh water is a global problem. This is more evident when there is a conflict between two places or regions over a common water source or there is an economic competition between two places or regions. However, the main driving forces for rising global demand for water are the increasing world population, improving standards, changing consumption patterns (Postel *et al.* 1996) and expansion of irrigated agriculture. Climate change (droughts and floods), deforestation, increased water pollution and wasteful use of water can also cause insufficient water supply (WWF 2013, Liu *et al.* 2017). Excessive deforestation is reducing rainfall leading to droughts in many parts of the world. Global warming is increasing the temperature of water and consequently depleting the dissolved

oxygen in the water, killing aquatic species and organisms and causing destabilization of the aquatic ecosystem. Glaciers are also melting due to global warming. As a result, the sea level is rising and gradually flooding the island and fresh water bodies are merging with the seas and becoming useless to drink. Another major cause of water crisis is the high rate of construction of buildings in urban and suburban areas which requires a large volume of water reducing ground water level which is gradually going down.

**Water pollution**

A pollutant is a waste material that pollutes natural resources i.e. air, water and soil. It is a by-product of human activities which enter or become concentrated in the environment, where it may cause injury to humans and desirable species (Allaby 1994). It may be foreign substance or energy or naturally occurring; when naturally occurring, it is considered contaminant when it exceeds natural level. Water is the most vital component responsible for the sustenance of the life. Almost all the water bodies are more or less polluted. Water pollution is the contamination of water bodies such as lakes, rivers, oceans and ground water by the release of waste products and contaminants into surface runoff into river fringe systems, leaching into ground water, liquid spills, water discharges, eutrophication and littering. Major causes of water pollution are the discharge of waste water from urban areas. Other important sources of pollution are the use of chemical fertilizers and pesticides in agriculture, accidental spillage of oil and industrial chemicals, discharge of sludge to rivers and disposal of solid wastes to

land filling (Banerjee 2010). Mishra and Tripathi (2000) reported that the discharge sewage adversely affected algal community structure and phytoplankton of river Ganga near Varanasi. Municipal as well as industrial effluents contain

different heavy metals toxic to the plants and animals. Heavy metal contents in sewage effluents of different discharge points of Kolkata city are given below (Adhikary *et al.* 1994).

**Table 2. Metal contents (ppb) in sewage effluents of different discharge points**

Location	Monsoon (toxic metals)								
	Fe	Cu	Mn	Zn	Pb	Cd	Cr	Co	Ni
Palmerbazar	472.0	5.2	4.0	248.2	5.6	Tr	Tr	Tr	Tr
Ballygunge	94.0	1.6	7.8	132.0	5.0	Tr	Tr	Tr	Tr
Topsia	142.0	5.2	4.0	134.6	8.8	Tr	Tr	Tr	Tr
Kuliadanga	92.0	5.1	1.2	151.8	4.0	Tr	Tr	Tr	2.8
Pagladanga	182.0	6.7	6.2	202.6	8.5	Tr	3.8	4.1	15.8
Dhapalock	142.6	2.0	2.2	72.4	7.8	Tr	Tr	Tr	Tr
Chingrighata	41.8	2.1	6.6	120.0	11.2	Tr	Tr	2.4	6.0
Chainatown	132.0	1.7	2.0	68.0	18.0	0.6	29.6	31.3	58.0
	Winter (toxic metals)								
Palmerbazar	500.0	5.6	4.4	260.0	6.0	0.9	Tr	Tr	8.0
Ballygunge	100.0	1.6	8.4	140.0	5.0	Tr	1.5	6.0	6.0
Topsia	150.0	5.6	4.4	140.0	9.0	Tr	Tr	Tr	12.0
Kuliadanga	100.0	5.6	1.4	160.0	4.5	Tr	2.0	Tr	20.0
Pagladanga	200.0	7.2	7.0	220.0	9.0	2.0	13.0	10.2	36.0
Dhapalock	150.0	2.4	2.2	80.0	8.0	Tr	Tr	6.0	16.0
Chingrighata	50.0	2.4	7.2	14.0	12.0	Tr	Tr	7.0	16.0
Chainatown	150.0	2.0	2.2	80.0	18.0	0.6	29.0	41.0	74.0

Tr. – Trace

Almost all the water bodies are more or less polluted. The pollution is usually caused by man-made activities. About 60 per cent of water pollution is caused by municipal sewage. In India, most of the rivers at various stretches suffer from pollution because a large number of

industries discharge their effluents into the river. Water pollution is also caused when silt and other suspended solids such as soil, waste off plowed fields, construction and logging sites, urban areas and eroded river banks when it rains (Table 3).

**Table 3. The major sources of pollution of Indian rivers**

Name of the river	Sources of pollution
Ganga (Near Kanpur)	Chemical, metal and surgical instrument industries, tanneries and textile mills

Jamuna (Near Delhi)	DDT factory, Mathura refineries, Indraprastha power station
Bhadra (Karnataka)	Paper and still industries
Cavery (Tamil Nadu)	Tanneries, distilleries, rayon and paper mills
Godavari (A.P.)	Paper mills
Hooghly (Kolkata)	Power stations, chemical mills, paper, pulp, jute, textiles, paint, vegetable oils, rayon, soap, match, tanneries
Damodar (Between Bokaro and Panchet)	Fertilizers, steel mills, power stations. Coal washeries
Narmada (M.P.)	Paper mills
Sone (U.P.)	Paper mills
Gomti (near Lucknow)	Paper and pulp mills

Source – Banerjee 2010

Sources of surface water pollution are generally grouped into two categories based on their origin viz. point source pollution and non-point source pollution. Notable examples of point sources are the sewage treatment plants of factory, power plants and drainage system. Tons of toxic substances from these sources fall into the ponds, lakes, rivers and reservoirs every year. Secondly, because of industrial accidents the chemicals catastrophically contaminate waterways and when the chemicals leached out of contaminated soil cause pollution. Agricultural farms, gardens and lawns, urban roads etc. are included in non-point source of pollution. It refers to diffuse contamination that does not originate from a single discrete source. It occurs via pesticide runoff from agricultural fields, runoff of saline irrigation water from crop lands as also runoff of automotive fluids and other chemicals from roads, parking lots, forests etc. The degree of pollution depends on the state of the receiving water bodies. The stagnant water of ponds and lakes become much more polluted than rivers and canals. In summer, the concentration of pollutants increases. In rivers and canals, the pollutants cannot accumulate much due to

flowing water. Pollutants can be divided into physical, chemical and organic.

*Physical pollutants:* Thermal pollution is one of the man-made physical disorders of aquatic ecosystem. Hot water from various factories, electric furnaces, power plants etc. contributes to this pollution. This results in the decrease in dissolved oxygen leading to the death of aquatic flora and fauna. The elevated temperature also affects the breeding of fishes in water bodies. Fly ash the waste product of thermal power plants consists of a large number of heavy metals which are toxic and pollute the air, water, soil and vegetation. Ash when blown by winds, not only creates air pollution but also affects water, soil and crop lands by deposition of silica and heavy toxic metals. Use of fly ash in agricultural fields as soil mediator causes leaching of the heavy metals into water thereby creating secondary pollution. The Rihand Reservoir, the only source of portable water for people in Singrauli district of M.P. and Sonbhadra district U.P. was contaminated making the water unfit for drinking. The destruction of mangroves, drastic reduction of crop yields and the pollution of ground water in Rann of Kutch from the ash sludge of

adjoining power plants has been well documented.

*Chemical pollutants:* The chemical pollutants due to heavy metals such as copper, chromium, cadmium, zinc, lead, mercury etc. released from power plants and other industrial activities are extremely harmful. These metals when mixed with water cause metallic poisoning. Arsenic can enter drinking water supplies from natural deposits of the earth or from agricultural fields or industrial practices. This problem is widely experienced in many regions across India. Consumption of it through drinking water can cause skin damage, circulatory system problems and on increased risk of lung and kidney cancer. Fluoride is the major naturally occurring contaminant in drinking water. It is found in high levels in East and North India and can cause structural tooth damage (Nehra and Trivedi 2008).

*Organic pollutants:* Organic pollutants include phenols, oil, grease, various pesticides, insecticides, herbicides, various organisms such as phytoplankton, coliform bacteria etc. The presence of organic pollutants in water may produce toxic chemicals during disinfection. These pollutants may reach marine water through migration from source by water currents. These chemically active compounds may also include micro-plastics, leaching of chemical additives and persistent organic pollutants (POP). POPs are resistant to environmental degradation through chemical, biological and photolytic processes. POP exposure may cause developmental defects, chronic illness and death (El-Shahawi *et al.* 2010). Organic pollutants originate from domestic sewage, urban runoff, industrial effluents and farm wastes. Sewage effluents are the greatest

source of organic materials discharged to fresh water. More than a quarter of the world's rivers sampled in a major new study (Limb 2022) are found to be polluted with drugs to a toxic degree. When antibiotics get into the water ways they make it more likely for bacteria to develop antimicrobial resistance – which is said by the WHO and UN to be one of the biggest dangers to humanity.

#### **Effect of water scarcity**

Water scarcity has a huge impact on hunger, health, habitat loss and destruction of ecosystem, poverty, disappearance of wet lands etc. According to United Nations (UN) 2013 Report on *Water for Life*, more than 1.1 billion people lack access to clear drinking water. With the current consumption rate, two-thirds of the world's population may face water shortages by 2025. As per the report, 21 Indian cities are running out of their main sources of water i.e. ground water by 2020. The report goes on to say that nearly 40% of the population will have absolutely no access to drinking water by 2030. The practice of growing crops and farming is greatly impacted and contributes to lower yields and death of animals particularly in arid regions in hunger, poverty and thirst. In many developing nations water scarcity forces people to drink water from flowing streams, majority of which are contaminated. Accordingly they are infected with water borne diseases such as cholera, typhoid and dysentery that kill people. Water shortage may also mean sewage systems are stagnant which create room for the buildup of bacteria and harmful insects that result in infection.

Access to quality water is fundamental to better living standard and economic growth. Manufacturing and industrial processes, mining activities and

commercial businesses all need large quantities of water to flourish. Without economic activities because of lack of water will generate higher poverty levels and poor living standards. When water is scarce, natural landscapes will suffer the most as it contributes to desertification, loss of plants and death of wild life and other animals. As a result, ecological catastrophes create habitat loss that in turn leads to food shortage and poor quality of life.

According to WWF, more than half of the planet's wetlands have been lost since 1990 which is largely due to water scarcity. The wetlands have become dry to the point of losing their natural capability to hold water.

Water scarcity makes it difficult for people to get the education that they need because they are working to help get water to the home and the family. In a region suffering from severe water shortage, some animals may become extinct simply they starve or die of thirst. Many plants may no longer be able to grow or reproduce in a sufficient manner causing serious biodiversity loss. Moreover, when large areas of land may no longer be suitable for living or farming because of water scarcity, millions of people may lose their livelihood; these people may be forced to migrate to other places to survive.

### **Solution and conclusion**

Rain water should be used extensively. The water crisis can be largely alleviated by collecting rain water and refilling underground aquifers. In addition, natural water sources can be made useable by preventing water pollution through proper arrangements for water pollution control, drainage and sanitation. Moreover, the water crisis can be greatly reduced by making sea water portable and useable

through advanced technology which is being implemented in developed countries. Emphasis should be given for large scale afforestation to prevent global warming ultimately reducing climate change. The preservation of natural wetlands provides a relatively simple water pollution solution. Additional water pollution solution involves reducing nutrient and pesticide pollution by encouraging smarter agricultural practices. The solid waste should be recycled for many beneficial purposes after composting. Khan *et al.* (1981) reported favourable effects of application of decomposed city wastes on soil fertility as well as physical environmental condition.

The Government of India has taken steps to prevent the pollution of rivers. The "Ganga Action Plan" was launched in 1986 to protect the river from hazards of pollution. "Namami Ganga Programme" is another Integrated Conservation Mission for the conservation and rejuvenation of the National River Ganges. India Government also launched a project called "Zero Liquid Discharge (ZLD)" to prevent waste water from factories and municipalities from flowing into different rivers.

There are many other water pollution solutions: 1) improve storm water management and water shed monitoring, 2) stop deforestation, 3) avoid use plastic and plastic products, 4) large scale afforestation. There is an urgent need for intense awareness on various environmental issues involving school and college students as well as clubs and NGOs that the environment should be kept clean and green especially to the future generation.

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## Seed borer, *Sitotroga cerealella* in bamboos and its control measures

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### Abstract

The present article deals with a seed borer, *Sitotroga cerealella* Olivier (Lepidoptera: Gelechiidae) in bamboos. The pest profile of this insect has been described and control measures have been highlighted.

**Key words:** Bamboo, seed borer, *Sitotroga cerealella*, control measures.

### Introduction

Bamboos (family Poaceae) are grasses the larger, woody bamboos serve the many functions of trees and are raised in plantations. There are vast stretches of bamboo forest in South and Southeast Asia, where the majority of about 1250 world species are distributed. Bamboos occur gregariously in large patches or as under-storey in mixed forests. India alone has about 10 million ha of area under bamboos (Sharma, 1987). Bamboos are one of the important and precious non-woody bioresources, which are used for a variety of purposes and is known as 'poor man's timber' (Fig.1).

Bamboos are liable to be attacked by various kinds of insects (Beeson, 1941; Mathur, 1943; Bhasin *et al.*, 1958; Mathur and Singh, 1959; Browne, 1968; Mathew and Varma, 1988, 1990; Singh and Bhandari, 1988; Tewari, 1992; Singh, 1990; Joshi *et al.*, 2008; Roychoudhury and Mishra, 2022). Insect pests of bamboos have been reviewed and described by Haojie *et al.* (1998). They gave a checklist of 70 defoliators, 117 sap suckers, 29 culm and shoot borers, 4 gall makers, 17 rhizome and root feeders and 2 seed feeders, a total of 239 species. None of the pests can be rated as serious pests in the tropics (Nair, 2007), although Haojie *et al.* (1998) have given 'major pest' status to six defoliators, eight sap suckers, nine borers, one gall maker and one seed pest, *Sitotroga cerealella* Olivier (Lepidoptera: Gelechiidae). This seed borer often recorded to damage seeds while they are on standing bamboo during flowering and seed setting (Fig. 2) or in storage.





Fig. 1. Bamboo the ‘poor man’s timber’



Fig.2. Flowering and seed formation in bamboo

### Pest profile

*Sitotroga cerealella* Olivier (Lepidoptera: Gelechiidae)

*S. cerealella* is commonly known as grain moth. It is a cosmopolitan pest of grains of various kinds. The caterpillars feed and bore the bamboo seeds from April to October (Mathur et al., 1958) (Fig. 3). The full grown larva is white with yellowish brown head and measures 3-5 mm in length. The larval period is 15-16 days. It overwinters as a hibernating larva and pupates in early spring. The pupal period lasts for about 8 days. The pupa is found in a small cocoon inside the grain. The moth is very small shining, buff, grey-yellow, brown measuring 10-12 mm in wing expansion (Atwal, 1976). After

emergence, the moth mates within 24 hrs and the female lays eggs singly or in batches on or near the seed. The small, white eggs hatch within 8 days. The newly hatched larva bores the seed soon after hatching and feeds on seed content. The length of life cycle is about one month with an egg period of 6 days, larval period of about 15-16 days and pupal period of 8 days. In colder month the life cycle completes in two and half months.

*S. cerealella* also causes considerable damage to stored paddy, wheat, maize sorghum, barley, oats etc during monsoon. The borer consumes usually 30-50% of the contents are consumed by this pest. It may sometimes consume more than this.



Fig.3. Bamboo seeds infested by *Sitotroga cerealella*

### Control measures

The eggs of *S. cerealella* are frequently parasitized by *Trichogramma evanescens* and consequently are, sometimes, employed for mass breeding of the parasitoids in biological control (Beeson, 1941). The successful rearing of egg parasitoid, *T. ostrinae* has also been carried out on *S. cerealella* eggs (Pitcher et al., 2002). These egg parasitoids can be

used to control the pest population of *S. cerealella*. The harvested bamboo seeds should be properly dried in sun light and stored in well packed containers after mixing with 2% Folidol (Methyl parathion) dust in ratio of 1:100 ( 1 part dust : 100 part seeds) (Joshi, 1992).

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